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# Market Structure and Performance: An Anti-Trust Story of Endogenous Growth

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# **Market Structure and Performance: an Anti-trust Story of Endogenous Growth**

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# **Market Structure and Performance: an Anti-trust Story of Endogenous Growth<sup>1</sup>**

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## **ABSTRACT**

Since Schumpeter, a major concern has been: what monopoly does to growth? Monopoly's static, allocative inefficiency is well established. How much this is offset by its dynamic progressiveness is unclear. First, using the empirical literature, we argue that the presumed progressiveness of monopoly must be rejected. Second, we extend the endogenous growth model to obtain a full Pareto ranking of competition, monopoly, Cournot and Bertrand. Competition beats Cournot, which in turn beats monopoly. Growth rate is invariant with structures, which accords well with empirical evidence. Bertrand happens to share the ranking with competition. The findings have a strong anti-trust overtone.

*JEL classification:* E10; L16; O30; O40

*Keywords:* Growth; Market Structure; Schumpeterian hypothesis; R&D; Externalities.

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## 1. INTRODUCTION

At least since Schumpeter (1942), a major concern in economics has been whether a case can be built for monopoly's dynamic efficiency. The verdict, as far as Schumpeter is concerned, is clearly in favor of monopoly and against competition. In his famous chapter on "The Process of Creative Destruction," he writes enthusiastically about the virtue and the progress of capitalism, about how spectacular improvements in our society are achieved and that "... big business may have had more to do with creating that standard of life than with keeping it down" (p.82). At the same time, and with no less fervor, he laments competition as "A system – any system, economic or other – that at every point of time fully utilizes its possibilities to the best advantage may yet *in the long run* be inferior to a system that does so at no given point of time, because the latter's failure to do so may be a condition for the level or speed of long-run performance" (p.83, italics added).

There have been countless empirical and theoretical papers to evaluate this 'Schumpeter hypothesis', or, shall we call it, the Schumpeterian controversy. In the first place, what is meant by this hypothesis is never clear. A careful rereading of the above passages conveys a distinction between the static virtues of competition and the dynamic progressiveness of monopoly. So, monopoly power is supposed to have a positive impact on how the society progresses "in the long run". In modern parlance Schumpeter would perhaps have said that if a society's productive activity is organized under larger businesses and with greater market power, then this society will exhibit a faster long-term rate of economic growth; in addition, the benefit that this bestows to the society is more important than the static allocative efficiency of competition.

At least since Solow (1956), there is a clear distinction between the level effect and the rate of growth effect in economic development. It is now well known, thanks to the wave of endogenous growth models led by Arrow (1962), Romer (1986, 1990), Lucas (1988), Grossman

and Helpman (1991) and Aghion and Howitt (1992), that external effects in learning, R&D, physical and/or human capital accumulation can generate, and alter, long-term growth rates. Two inferences are therefore immediate. First, the progressiveness of monopoly capitalism in the Schumpeterian hypothesis must be at least primarily, if not predominantly, about the rate of growth effect instead of the level effect. Second, amongst the host of factors we have just mentioned, R&D comes closest to Schumpeter's description of how monopoly is linked to growth. R&D expenditure of major industrial countries has, indeed, risen consistently and significantly over the past century.

The real issue, however, is not really whether monopoly is more innovative, or if it yields faster growth. This question is important, and we will examine it carefully Section 2. What really matters, even if monopoly is dynamically more progressive, is whether this outweighs the static, level inefficiency effect of monopoly. All monopoly, unregulated, will produce an output level that is less than socially optimal. This static inefficiency, called the triangular deadweight loss, has not been incorporated into the growth literature. When this is done, and when the monopoly's rate of growth effect is also established, then we may hope to arrive at a conclusion on the Schumpeterian hypothesis. This, in short, is the purpose of the present paper.

More specifically, my plan is as follows. In Section 2 I will discuss the rate of growth effect of market power. A clear picture emerges by examining several interesting findings that have become available in the recent literature. Sections 3 and 4 then study the level effect of various market structures. I will seek to rank competition, monopoly, Cournot and Bertrand by their relative position to the Pareto optimum. This, for the first time, links endogenous growth to the full spectrum of market structure. Section 5 combines the rate of growth and the level effects, and concludes the essay.

## **2. MARKET CONCENTRATION AND THE RATE OF ECONOMIC GROWTH**

Does market power promote faster long-term growth? In this section I will address this question by, first of all, examining the existing empirical evidence in the literature. The next question is how to reconcile and understand what we observe empirically with recent developments in theoretical models of endogenous growth.

The most direct way to find out if concentration promotes growth is to ask whether market structure has changed in recent decades and whether that has caused persistent changes in growth rate. This is similar to the approach adopted by Jones (1995a), in which he tests the endogenous growth models. Jones finds that OECD countries in the 20<sup>th</sup> century significantly increased their R&D activities. Growth rates, however, have remained remarkably constant. Since it is most unlikely that other factors have exactly offsetting effects to preserve constant growth, Jones concludes that R&D has no persistent effect on long-term growth.

So growth rates in OECD countries have been largely constant in the 20<sup>th</sup> century. Market structure must not have changed violently if it affects growth; or else exactly offsetting movements in other factors are again required. There is widespread agreement that market structure has been on the rise for much of the 20<sup>th</sup> century.<sup>2</sup> A representative study is Prais (1976), which reports that in the U.K., the 100-firm concentration ratio increased by 156 percent from 16 in 1909 to 41 in 1970; and in the U.S., it increased by 50 percent from 22 to 33 over the same period. In addition, the increase in concentration has been gradual and persistent, a manner that would elicit changes in growth rates. Admittedly, opinion on this has not been unanimous,

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<sup>2</sup> Movement in market concentration is an old topic and the most comprehensive survey I know of is Curry and George (1983, pp.227-9). The extensive evidence cited in their survey was clearly in support of rising market concentration in the 20 century.

but the great majority of papers in the literature are generally in support of Prais. Among the dissenting voices, an important one is Shepherd (1982). He begins by reporting, in agreement with Prais, that there was a substantial rise in market concentration in U.S. manufacturing from 1909 to 1970. But when he studies the aggregate economy, he finds that competition increased from 1939 to 1980. He attributes the rise in competition to imports, anti-trust, and deregulation. However, even if concentration has retreated temporarily during the post-WWII decades, there is strong recent evidence that market power is again on the rise since 1980. According to Pryor (2001), throughout the 1980s and the 1990s, market concentration has been rising across the United States. Pryor believes that the merger waves in these decades have increased monopoly power significantly.

The general picture is that market concentration has risen for most of the 20<sup>th</sup> century, perhaps with momentary resurgence of competition. Indeed the rise in concentration may help to explain the significant rise in R&D activities reported by Jones. The conclusive evidence, again, is that OECD growth rates have remained remarkably constant. In major industrial countries the rise in market concentration has failed to change long-term growth rate. The presumed progressiveness of monopoly capitalism has not passed the empirical test as far as the long-term rate of growth is concerned.

So why has market structure failed to connect to growth? As mentioned earlier, R&D is the most eligible candidate worthy of investigation. As Jones (1995a) has shown, R&D indeed rose significantly during the past decades. It is not important whether the intensity of R&D was raised by the observed rise in concentration. Even if it was, the crucial question is why the increase in R&D has failed to raise the long-term rate of income growth.

The possible influence of R&D on long-term growth has currently been subject to a great deal of discussion in the literature. Debates have centered on the specification of how the

residual technology in production evolves over time, and, in particular, on whether the level of technology increases or decreases speed of technological change. The question is, in other words, whether there are decreasing returns to R&D activity. The literature has been aptly summarized by Jones (1999), and there is no need to describe it here.

To illustrate the point, we may take a closer look at a recent response to the absence of a scale effect that has not been discussed in Jones (1999). Peretto and Smulders (2002) suggest that as society's technology level increases, so does the distance of each firm's technology to that of the society. The externally, or socially, shared technology becomes more and more remote, and less and less applicable to one's own. This 'knowledge dilution' as Peretto and Smulders call it, is in effect a negative spillover rising with the size of the economy. It counteracts the original positive knowledge spillover, and asymptotically eliminates endogenous growth. The conclusion, shared in varying degree by Jones (1995b), Smulders and Klundert (1995), Peretto (1996, 1999), and Young (1998), has the effect of revitalizing the classic growth conclusion of Solow (1956), where growth rate depends on population growth, but not on the saving rate or government policies.

Like the saving rate, monopoly power may only have transient level effects on the economy, and not have any effects on the rate of long-term growth. The intuition that emerges from the literature is that monopoly is not so much a less efficient researcher than competition, but rather that there could be strong diminishing returns in research. It could also be that monopoly does more research that generates different varieties of products, or creates different ways of doing the same thing, compared to competition. The society may become more varied, and consumer choices may increase under monopoly. A greater assortment of choices could enhance welfare. Comparing welfare gain from a richer choice set with that from the traditional measure of greater



quantity is an important but difficult issue that will not be addressed here. It could be a rewarding direction for future research.

Still, the empirical fact remains that growth rate has not changed, despite the shifts in market concentration. Returning to the Schumpeterian hypothesis, we have no choice, so long as we adhere to the view that more progress equates to faster growth of per capita output, but to largely discount the progressiveness of monopoly power. What is left is its level effect. This is the subject that I will examine in details in the next section.

### **3. EXTERNALITIES, MARKET STRUCTURE AND GROWTH**

Recent papers by Smulders and Klundert (1995), Peretto (1996, 1999), and Duranton (2000) have begun to extend main-stream endogenous growth models of Romer (1986, 1990), Grossman and Helpman (1991), and Aghion and Howitt (1992) beyond the market structure of monopolistic competition. For the most part, the new models have focused on endogenous market structure, which is determined by sunken R&D. The complexity of endogeneity, however, has limited the scope of structures examined. It has not been shown, for instance, how monopoly compares to competition, and how monopoly and competition compare to various types of oligopoly as an economy grows. To obtain sharp comparisons, I will assume exogenous market structure in what follows. This is a strong assumption, but the reward is a full set of Pareto ranking of all the major market structures. In addition, in this model growth rate turns out to be invariant to market structures, which is consistent to the empirical finding of Jones (1995a) noted in the last section.

I will adopt a type of endogenous growth described by Romer (1986). In this model, externalities are generated by individual firms' production activity. It is external to the firm, since each one is too small to realize its contribution to the aggregate knowledge stock. An

infinitely large number of firms operating side-by-side, however, determine the aggregate knowledge stock and total productivity. This way of reconciling competition with aggregate increasing returns can be traced to at least Marshall (1920). A more familiar textbook application of this idea is that each competitive firm takes price as given, yet it is the aggregate output decision that determines the market price. Romer (1986) gives a careful interpretation of this externality, which drives growth.

One way to describe this economy is that its whole is greater than the sum of its parts. First, we have to choose a production function that conveniently preserves competition at the firm level, yet allows increasing returns in the economy. Imagine an economy with one consumption good, denoted  $y$ , which is produced by capital  $k$  and labor  $l$ . Externalities are generated by the use of capital in production. This is much simpler than learning-by-doing in the sense of Arrow (1962). Each firm indeed learns and generates knowledge, but, first, this knowledge contributes only to the common efficiency of industry production, and cannot be retained as proprietary to the firm. Second, this effect is so insignificant to the firm that it is ignored in its profit calculations. However, the industry is immense compared to each individual firm. The sum total of individual firms' contribution is indeed significant, and it propels productivity development and growth.

A brief comment should be made about the number of firms. In competitive price determination, the number of firms plays no significant role at all and is thus arbitrary. For similar reasons this number has no significance to the argument of externalities. It simplifies the model and we lose no generality by keeping the number of firms implicit and in the background. Romer (1986) adopted the same modeling strategy. It is the aggregate quantity that counts, not the number of firms that produce the quantity. Moreover, since much of the analysis can be conducted in a static setting, all time references are therefore suppressed.

Let the production function satisfy

$$(1) \quad y = K^\beta k^\alpha l^{1-\alpha}, \quad 0 < \alpha < 1; \beta > 0.$$

$K$  is external effect, and the Hicks-neutral total productivity is  $K^\beta$ . At the firm's level, production is Cobb-Douglas since each treats  $K^\beta$  as a constant. At the industry level, however,  $K$  is aggregate capital arising from, and equal to, the economy's aggregate usage of  $k$ . There is externality since  $\beta > 0$ , and the extent of externality increases with both  $\beta$  and  $K$ .

In this section I will present the analysis in the order of competition (which is the same as Romer's result in his 1986 paper), then monopoly, then the social planner, then the monopoly again but this time with the externalities internalized. It is convenient to start with Romer, since that links my paper directly to the literature on growth.

### 3.1. EXTERNALITY AND COMPETITION (ROMER)

Since all  $y$ -producers face the Cobb-Douglas function (1), the industry will be competitive and price-taking. Assigning  $y$  the role of the numeraire, and denoting the demand price for  $k$  by  $r(k)$ , the aggregate demand for capital is

$$(2) \quad r(k) = \alpha K^\beta k^{\alpha-1} l^{1-\alpha} = \alpha k^{\alpha+\beta-1} l^{1-\alpha}.$$

As shown by the second equality, the equilibrium process internalizes the externality. The atomistic  $y$ -firms in aggregate hire some amount of capital  $k$ , each failing to notice that their action in total generates an external effect  $K = k$ . That allows me to express the demand price for capital as  $\alpha k^{\alpha+\beta-1} l^{1-\alpha}$  in (2). To ensure the negative slope of the demand curve, I shall assume  $\beta < 1 - \alpha$ , that is, that externality is 'not too strong'. If this assumption fails to hold, in other words if externality is too large, equilibrium in the capital-good industry may not exist. In that case, a steady state growth path also fails to exist. This claim will be verified shortly.

Following Romer (1986), suppose the capital-good industry is also competitive. For simplicity, one unit of  $y$  (the numeraire) is convertible into one unit of  $k$ . Here we can see that the problem has no dynamics since savings and investment are fully independent in this economy. Equilibrium requires the demand for capital to be equal to the horizontal supply curve of capital, which implies

$$(3) \quad \alpha k^{\alpha+\beta-1} l^{1-\alpha} = 1.$$

Equation (3) must hold in the long-term steady state, and from this the aggregate growth rate of capital is easily derived. Assuming a constant exogenous rate of population (labor) growth,  $\mu$ , the constant growth rate of capital is

$$(4) \quad g \equiv \frac{\dot{k}}{k} = \frac{1-\alpha}{1-\alpha-\beta} \cdot \mu.$$

Next, the per capita growth rate of  $k$  is simply  $g - \mu$ , which is obtained from (4)

$$(5) \quad g - \mu = \frac{\beta}{1-\alpha-\beta} \cdot \mu.$$

The rationale for our assumption  $\beta < 1-\alpha$  is now apparent.  $\beta > 1-\alpha$  would have implied negative growth. Clearly the growth rate of capital, both aggregate and per capita, increases with  $\beta$ . This, of course, was the thesis of Romer. In fact, if we allow  $\beta$  to rise and to approach  $1-\alpha$ , growth rate increases without bound.

In what follows, equation (3) and its counter parts, to be developed below, suffice for a complete Pareto ranking of all the market structures. In this simple economy, aggregate as well as per capita consumption clearly depend on  $k$ . For that reason, consumption growth rate depends on the rate of growth of  $k$ . For the sake of comparing between market structures, I do not even have to specify consumption and utility explicitly. Since the marginal cost of capital is 1,

everything in this system is generated by the marginal revenue of capital, which, of course, reflects the market structure of the capital industry. I now turn to the structure of monopoly.

### 3.2. EXTERNALITIES AND MONOPOLY

The production function of the final consumption good again satisfies (1), and because of externalities the demand for  $k$  satisfies (2).

Suppose capital is supplied by a monopoly. Unlike the competitive industry in subsection (3.1), in which each firm takes  $r(k)$  as given, the monopolist chooses  $k$  to maximize profits

$$(6) \quad \Pi(k) = r(k)k - \phi(k) = \alpha k^{\alpha+\beta} l^{1-\alpha} - k.$$

In the second equality in (6) we have used (2), and the previous assumption of constant unit production cost of  $k$ .

Maximizing (6) using (2) gives

$$(7) \quad \alpha(\alpha + \beta)k^{\alpha+\beta-1} l^{1-\alpha} = 1.$$

It is routine to check the growth rate of capital  $g$  is again given by (4) along the steady state growth path, and that the growth rate of per capita capital is given by (5). Both competition and monopoly will have the same growth rate. As mentioned earlier, one of our results is that market structure does not change long-term growth rate. This will hold for all the structures examined below. The monopoly will supply a different (smaller, see below) quantity of  $k$  than competition, but as it does so in every period, and always to the same extent, thus its growth rate of  $k$  is exactly the same as that under competition.

To obtain these different levels of  $k$  along the two growth paths, we simply compare (3) and (7). Clearly the equilibrium level of  $y$  produced under monopoly must be *smaller* under (7) than under (3). More precisely, monopoly's output level must be  $\alpha + \beta (< 1)$  times that of

competition's, and the proportional difference, as noted earlier, is the same always as the economy grows.

The reason for the lower output level under monopoly is simple. Restricting output to increase profits is what monopolies do. The immediate question is: How far is that from optimal? The benchmark Pareto position, because of externalities, is not competition as established in subsection (3.1). Romer (1986), of course, noted that. The justification for social planning, in Romer's case, comes from the externalities depicted in (2). We have, in addition, another justification owing to non-competitive market structures.

To establish the benchmark for welfare rankings, I now turn to the social planner's problem.

### 3.3. INTERNALIZED EXTERNALITIES AND COMPETITION (SOCIAL PLANNER)

The sources of inefficiencies in my system are externalities and monopoly. Internalizing the externalities, for instance by means of a system of lump-sum taxes and subsidies, and maintaining competition, could correct both inefficiencies and achieve the social optimum.

When externalities are internalized, the production function becomes  $y = k^{\alpha+\beta} l^{1-\alpha}$ , and the demand for  $k$  is

$$(8) \quad r(k) = (\alpha + \beta) k^{\alpha+\beta-1} l^{1-\alpha}.$$

Under competitive supply of  $k$ , its rental price should be equal to the marginal cost, thus

$$(9) \quad (\alpha + \beta) k^{\alpha+\beta-1} l^{1-\alpha} = 1.$$

Not surprisingly, the growth rates are the same as under competition (3.1) and monopoly (3.2), but the level of the variables is again different. Comparing (9) and (3), the competitive output level in (3.1) is less than socially optimal. That difference, as noted earlier, arises purely

from the externalities in the production function (1). It follows that the second inefficiency of the system, in which the output level of monopoly (3.2) falls short of competition's (3.1), arises purely from the social loss due to monopoly's restriction of output. The monopoly chooses its output by equating marginal cost to marginal revenue, which is lower than price.

### 3.4. INTERNALIZED EXTERNALITIES AND MONOPOLY

Since we have two structures, competition and monopoly, and two scenarios, externalities and internalization, there are altogether four cases to consider. Three of them have been examined above. To complete the picture we now turn to the remaining case of internalized externalities and monopoly.

Suppose we have a system, as mentioned in (3.3) above consisting of lump-sum taxes and subsidies, by which the externalities are internalized. However, the supply of  $k$  remains monopolized. When each  $y$ -firm internalizes the externality, the demand for  $k$  again satisfies (8). Using this, and the constant marginal cost of  $k$ , the monopoly's profits is

$$\Pi(k) = r(k)k - \phi(k) = (\alpha + \beta)k^{\alpha+\beta}l^{1-\alpha} - k.$$

Now the equilibrium, when the monopoly equates marginal cost to marginal revenue, implies

$$(10) \quad (\alpha + \beta)^2 k^{\alpha+\beta-1} l^{1-\alpha} = 1.$$

The growth rates are again the same as in the three cases before, but the levels of the variables differ. Under monopoly in (3.4), the level of output of  $y$  is again less than socially optimal, but it is larger than that under (3.2) because now externalities are no longer a problem.

To summarize, the welfare rankings of the four cases studied thus far depend on the following parameters:

- 3.1:**  $\alpha$  [Externalities and competition (Romer)]
- 3.2:**  $\alpha(\alpha + \beta)$  [Externalities and monopoly]
- 3.3:**  $(\alpha + \beta)$  [Internalized externalities and competition (social planner)]
- 3.4:**  $(\alpha + \beta)(\alpha + \beta)$  [Internalized externalities and monopoly]

Recall our equilibrium condition  $0 < \alpha + \beta < 1$ , and  $\beta > 0$  for a positive externality. The overall dominance of Pareto is immediate from **3.3**>**3.1**, **3.3**>**3.2**, and **3.3**>**3.4**. Since marginal cost is 1, marginal revenue is below the optimal value of the social planner in all the cases. We can see that competition beats monopoly on two counts. First, when there are externalities (**3.1**>**3.2**); and second, when externalities are internalized (**3.3**>**3.4**). Clearly, **3.2** is the worst of all states. Beginning from **3.2**, as competition improves welfare since **3.1**>**3.2**, so does internalizing externalities improve welfare since **3.4**>**3.2**. Finally it is easy to check that **3.1**>**3.4** if and only if

$$\beta < \sqrt{\alpha} - \alpha .$$

This says, somewhat trivially, that competition is more important than internalizing externalities, or, that monopoly is more damaging than externalities provided that externalities are sufficiently small.

#### 4. EXTERNALITIES AND OLIGOPOLY

It should be clear from the last section that internalizing externalities improves welfare under any given market structure. For that reason I shall leave the internalizing of externalities



aside in this section, and focus my investigation on market structures alone. An obvious direction to proceed is in that of oligopoly, and for that I shall examine Cournot and Bertrand. Not surprisingly, both of these structures are Pareto-preferred to monopoly, and both are, in their corresponding degrees, inferior to the social optimum.

#### 4.1. COURNOT OLIGOPOLY

Suppose production of the consumption good,  $y$ , still satisfies (1), and hence the market demand for capital satisfies (2). There are externalities.

Suppose this aggregate demand curve for  $y$  is shared by a pair of symmetric Cournot duopolies. The assumption of symmetry is for simplicity and should not affect the main results that follow. I can write the oligopoly supplies explicitly using firm subscripts, i.e.

$$(11) \quad r(k_1 + k_2) = \alpha (k_1 + k_2)^{\alpha+\beta-1} l^{1-\alpha}.$$

Firm 1, which assumes  $k_2$  constant, chooses  $k_1$  to maximize profits, which can be written as

$$(12) \quad \Pi_1(k_1, k_2) = r(k_1, k_2)k_1 - \phi(k_1) = \alpha (k_1 + k_2)^{\alpha+\beta-1} l^{1-\alpha} k_1 - k_1.$$

The first order condition is

$$(13) \quad \alpha(\alpha + \beta - 1)(k_1 + k_2)^{\alpha+\beta-2} l^{1-\alpha} k_1 + \alpha(k_1 + k_2)^{\alpha+\beta-1} l^{1-\alpha} = 1.$$

Because of symmetry, (13) applies for both firms. We are interested in total Cournot industry output, which is simply  $k = k_1 + k_2$ . Using this and  $k_1 = k/2$  in (13), we get

$$\alpha(\alpha + \beta - 1)k^{\alpha+\beta-2} l^{1-\alpha} \cdot \frac{k}{2} + \alpha k^{\alpha+\beta-1} l^{1-\alpha} = 1,$$

or,

$$(14) \quad \alpha \cdot \frac{\alpha + \beta + 1}{2} \cdot k^{\alpha+\beta-1} l^{1-\alpha} = 1.$$

Not surprisingly, the steady state growth rates are identical to those in Section 3, and more specifically to those given by (4) and (5). Since

$$\alpha > \alpha \cdot \frac{\alpha + \beta + 1}{2} > \alpha(\alpha + \beta),$$

we know **3.1**>**4.1**>**3.2**. Cournot Pareto-dominates monopoly, but is dominated by competition. This is exactly what we would expect, since total Cournot output is less than the competitive level, but Cournot competition raises it above the monopoly level. Needless to say, the social planner beats Cournot (**3.3**>**4.1**).

The ranking between (**3.4**) – internalized monopoly  $[(\alpha + \beta)(\alpha + \beta)]$ , and (**4.1**) – Cournot with externalities  $\left[\alpha \cdot \frac{\alpha + \beta + 1}{2}\right]$ , is ambiguous. When there are no externalities,  $\beta = 0$  then

**4.1**>**3.4**, so Cournot beats monopoly. Ceteris paribus, Cournot's output is higher than monopoly's, and that is all there is to it when there is no externalities. It is easily checked,

however, that  $d\left[(\alpha + \beta)^2 - \frac{\alpha(\alpha + \beta + 1)}{2}\right]/d\beta > 0$ . Thus, for values of  $\beta > \frac{\sqrt{\alpha(8 + \alpha)} - 3\alpha}{4}$ ,

$(\alpha + \beta)^2 > \frac{\alpha(\alpha + \beta + 1)}{2}$  and **3.4**>**4.1** so monopoly beats Cournot.<sup>3</sup> When internalization is

important, when there are a lot of externalities to be internalized, then we prefer a monopoly with externalities which are internalized, to a Cournot with externalities which are not internalized.

## 4.2. BERTRAND OLIGOPOLY

Production of the final consumption good satisfies (1), and the market demand for capital satisfies (2). Again, there are externalities.

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<sup>3</sup> If  $\alpha = 0.5$ ,  $\beta > 0.14$  will satisfy this inequality.

Suppose the economy's capital is supplied by a pair of symmetric Bertrand duopolies. Under this structure, Bertrand profit can be written as

$$\Pi_1(k_1, k_2) = r(k_1, k_2)k_1 - \phi(k_1) = \alpha(k_1 + k_2)^{\alpha+\beta-1} l^{1-\alpha} k_1 - k_1.$$

Now Bertrand price competition reduces profit to zero. By equating the right-hand side to zero, since aggregate capital is  $k = k_1 + k_2$ , we have

$$(15) \quad \alpha k^{\alpha+\beta-1} l^{1-\alpha} = 1.$$

The economy's growth rates are, again, unchanged as before. But clearly (15) is identical to (3), hence **4.2=3.1**, and Bertrand's Pareto ranking is identical to Romer's competition. Since marginal cost of  $k$  is constant, the competitive supply curve is also constant, and the number of firms under competition is immaterial. As long as profit is driven down to zero, having two Bertrand firms is just as good as having any number of competitive firms. This result may have interesting implications to the policy of breaking up a monopoly. If marginal cost is constant, and there is no fixed cost (or fixed cost reasonably small), then breaking up a monopoly into two Bertrand firms is as good as perfection competition.<sup>4</sup>

Since **4.2=3.1**, the position of Bertrand relative to other market structures can be inferred directly from that of **3.1**, which was discussed in detail at the end of Section 3. In particular, Bertrand beats monopoly but is, of course, inferior to the Pareto optimum **3.3**.

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<sup>4</sup> I admittedly have in mind the monopoly power of Microsoft. The condition of constant marginal cost is easier to justify than zero fixed cost. If there is a large fixed cost, the case is similar to a natural monopoly, and perfect competition cannot be sustained. The Bertrand firms will compete until each makes zero profits, and produce a positive output that is as large as can be sustained.

## 5. CONCLUSIONS

Two main arguments are presented in this paper. In Section 2, we utilize existing findings in the literature to show that the presumption of progressive monopoly capitalism cannot be accepted. Long-term growth rates in OECD countries such as the U.S. and U.K. were, by and large, constant for much of the 20<sup>th</sup> century, despite the fact that market concentration rose steadily, and R&D activities grew significantly. No matter how we may try to rationalize this, the conclusion remains that neither monopoly nor R&D moves the long-term rate of growth. As long as we adopt GDP growth rate as the benchmark for progress, a crucial part of the Schumpeterian hypothesis, that large businesses and monopoly are needed for progress, must be rejected by empirical evidence.

That leaves us to study, in Sections 3 and 4, the Pareto rankings of monopoly and other market structures in long-term growth. Since R&D does not matter, I am free to choose other, less specific externalities to generate the positive growth path. I find, given the Romer (1986) type of externalities, competition beats Cournot, which in turn beats monopoly. Since there is no additional progress to offset monopoly's allocative inefficiency along the growth path, the case is unambiguously in favor of competition and against monopoly.

Interestingly, Bertrand has exactly the same Pareto ranking as competition. However, this result assumes no fixed cost and constant marginal cost. Under these assumptions, both the firm's as well as the aggregate supply curve are horizontal. Firms compete in price until profit is entirely dissipated, so total output  $k$  must be the same under competition and Bertrand. This suggests, again with no fixed cost and constant marginal cost, breaking up a monopoly into a pair of Bertrand duopoly is as good as creating a perfectly competitive environment. Admittedly the cost assumptions are extreme, but at least we may hope to use them as benchmarks for policy evaluations.

In Section 2, we cite empirical studies to show that changes in market structure have not moved the permanent rate of growth. It is interesting and comforting to find, from the simple model with externality of Sections 3 and 4, that growth rate remains unchanged as we move from one market structure to another. The reason is simple. Monopoly, for example, restricts output but it does so to exactly the same extent at every point in time. Other market structures produce different output levels, but the proportional difference is unchanged also at every point in time. Hence market structure has a purely level effect, that is, no rate of growth effect. This accords well with empirical observations discussed in Section 2. The level effect, a main contribution of this paper, has not been noted before in the theoretical growth literature, and neither has it been documented empirically. This might be a worthwhile direction for future empirical research.

To conclude, the dynamic progressiveness of monopoly has failed to find any support, and the case against the monopoly's static allocative inefficiency is straightforwardly carried over to the endogenous growth setting.

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